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- Fig. 2. Same, enlarged about 10 times. The lines, *a-a*, *b-b*, indicate the direction of the sections of Fig. 53, and those marked A-A, B-B, those of Fig. 5; "*s*" is the scar where the frond was attached to its parent; "*um*" the outline of the upper membrane (drawn with 2 inch objective, 2 inch ocular, distance from camera to paper, 5 inches).
- Fig. 53. In text, longitudinal vertical sections, as marked in Fig. 2 (objective 2 in., ocular 2 in., distance 5 in.).
- Fig. 4. Section in the direction *e-e*, of Fig. 2: "*a*" young root; "*c*" its "summit region;" "*d*" its root-cap; "*b*" young bud; "*k*" lip or cover to the same; "*um*" upper membrane; "*lm*" lower membrane (objective  $\frac{3}{8}$  in., ocular 2 in., distance 10 in.).
- Fig. 5. Sections in the directions A-A, B-B, etc., of Fig. 2: "*s*" of C, D, and E, end of stem; "*rt*" roots; "*lm*" and "*um*" same as Fig. 4 (objective  $\frac{3}{8}$  in., ocular 2 in., distance 5).
- Fig. 6. Horizontal section in the direction of the arrows *a-a* of Fig. 8: "*rb*" the right hand bud or most developed; "*lb*" left hand bud; "*st*" the stem or axis; "*sc*" scar; "*v*" the veins or ribs of the frond; the arrows "*a-a*" show direction of the section of Fig. 8 (objective  $\frac{3}{8}$ , ocular 2, distance 5).
- Fig. 7. Outline plan of buds, with lines showing where different sections were made (objective  $\frac{3}{8}$ , ocular 2, distance 10).
- Fig. 8. Section through *a-a*, of Fig. 6. "*b*" bud; "*c*" roots. "*K*" same as *k*, Fig. 4 (objective  $\frac{3}{8}$ , ocular 2, distance 5).
- Fig. 9. Diagram of the directions of the axes of growth of the different generations.
- Fig. 10. Vertical section of the bud in the position and direction marked by "*e-e*, 5, Fig. 7," "*r*" root; "*f*" base of "*um*;" "*b*" budlet; "*a*" ridge of budlet, or rudiment of the upper membrane; "*d*" rudiment of lip or cover of bud cavity; "*lm*" and "*um*" as before. The lettering and amplification of Figs. 10, 11, 12 and 14, are the same (objective  $\frac{1}{4}$ , ocular 2, distance 10).
- Fig. 11. Section through "*g-g*, 12, of Fig. 7," "*n*" the rudiment of lower membrane.
- Fig. 12. Section through "*f-f*, 2 of Fig. 7," "*r-r*" roots below the plane of the rest of the drawing.
- Fig. 13. Section through "*b-b*, 5 of Fig. 7." For "*x y z*" see text.
- Fig. 14. View of the base of the bud of Fig. 6: "*e*" the growing point or budlet of the next generation; "*h*" corresponds with "*b*" of Fig. 6; for "*c*" and "*g*" see text.
- Fig. 51. In text, surface view of portion of upper membrane of frond (objective  $\frac{1}{8}$  ocular 2, distance 10).
- Fig. 55. In text, surface view of the upper membrane of the bud (objective  $\frac{1}{8}$ , ocular 2, distance 10).
- Fig. 56. In text, epidermis of frond with larger cells of the cellular tissue seen underneath, two of the latter containing crystals (objective  $\frac{1}{8}$ , ocular 2, distance 10).
- All the drawings are camera lucida work except Fig. 1 and a portion of the cells filling up the sectional views.

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## THE INFLUENCE OF INSECT-AGENCY ON THE DISTRIBUTION OF PLANTS.

BY F. BUCHANAN WHITE, M.D.

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IN urging botanists to study the influence that insect agency has upon the distribution of plants (see vol. x., p. 334), Mr. Bennett

points out a very interesting subject for investigation, and I trust that the readers of the Journal will not lose sight of it.

If *Sphinx Convolvuli* is the chief agent in the fertilization of *Convolvulus sepium*, then the reason why that plant seldom in Britain perfects seed (as is said to be the case) is readily explained. The moth is rare in Britain, and I do not at present remember any record of its having been seen visiting the flowers of *Convolvulus*, though it is generally taken in the act of hovering over flowers, notably *Petunia* and honeysuckle. Though *Sphinx Convolvuli* occurs throughout Britain (even beyond the range of *Convolvulus*, e.g. Orkney), yet it is most especially a southern insect, and perhaps that may account in some measure for the rarity in a wild state (at least in my experience) of *Convolvulus sepium* in Scotland.

*Dianthæcia* (a genus of night-flying moths) must exert a great influence upon the fertilization (and consequent abundance) of *Silene* and *Lychnis*. In fact, the perpetuation of the race of these moths depends upon the fertilization of the plants, since the larvæ feed only upon the unripe seeds. This is a case somewhat similar to, though by no means so extraordinary as, that mentioned by Professor Riley at the last meeting of the American Association for the Advancement of Science. Professor Riley showed how the fertilization of *Yucca* depended on the agency of a moth, the female of which collects the pollen and places it on the stigma, for the express purpose that the larvæ, produced from the eggs which she deposits on the ovary of the plant, may have a supply of unripe seeds to feed upon. In regard to *Lychnis* and *Silene*, it is possible that if there were no *Dianthæcia* the plants might be more numerous, since other moths visit the flowers, though the *Dianthæcia* are the chief visitors. *Silene maritima* is the most frequented species (it is, perhaps, worth remarking that it has also the largest flowers, and is, perhaps, the most numerous in individuals) of course, in proportion to its restricted usually maritime habitat; *Lychnis Flos-cuculi* is more especially visited by *Dianthæcia Cucubali*; and *Silene Otites* a plant of the eastern counties, by *Dianthæcia irregularis*. On the Continent this insect frequents *Gypsophila paniculata*. I know of no insect visitors to *Silene acaulis* and *Lychnis alpestris*. Possibly, if *Lychnis alpestris* had more insect visitors, it might be more abundant on our mountains, though the peculiarities of the locality (in Forfarshire, at least) have doubtless something to do with its restricted range.

It is probable that insects are the agents in the production of the numerous hybrids that occur between species of the genus *Carduus*, on the flat horizontal top of whose heads various species of *Lepidoptera* may often be seen. The downy bodies of these moths would readily convey pollen from one plant to another, and, when the plants were different species, hybridization might be the result in a genus the species of which seem so liable to that phenomenon. *Carduus Carolorum*, which is supposed to be a hybrid between *C. palustris* and *C. heterophyllus*, may have been produced by the agency of *Trichius fasciatus* (a beetle belonging to the family *Cetoniadæ*), whose thorax and underside are very shaggy, and which loves to bury its head and shoulders in the head of a thistle. This beetle is rather rare in Britain, but is not uncommon in the district where *Carduus Carolorum* was found.

The species of *Meligethes* (a genus of small beetles) inhabit flowers. M. Brisout, in *L' Abeille* (vol. viii., January, 1872) points out the flowers in which the various species are generally to be found. Among these are *Genista*, *Galium*, *Prunus spinosa*, *Symphytum officinale*, *Mercurialis perennis*, *Trifolium medium*, *Solanum Dulcamara*, *Melilotus*, *Cyanoglossum officinale*, *Lotus* and other *Leguminosæ*, *Lamium album*, *Galeopsis*, *Mentha*, *Marrubium vulgare*, *Nepeta Cataria*, *Ballota nigra*, *Teucrium Scorodonia*, *Salvia*, and other *Labiatae*. Many species affect only one kind of plant each, and in going from flower to flower cannot fail to carry pollen with them. *Teucrium Scorodonia* is a great favorite with many nocturnal *Lepidoptera*, and this, perhaps, partly accounts for the great number of individuals of this plant. Moths usually abound in places where the *Teucrium* grows.

Many flower-frequenting night moths have more or less strongly developed crests of hairs on the thorax. Many flowers frequented by these moths have blossoms with mouths directed to the horizon (*i. e.* neither drooping nor facing the zenith), and stamens more or less exserted and ascending; styles also more or less exserted. When a moth visits such a flower it either hovers in front of it and plunges its haustellum into the corolla, or else rests on the flower and does the same. In either case it brushes the stamens with its thorax, and carries off unwittingly a supply of pollen to the next flower visited. Now, it is worth noting that some of the moths which hover (*e. g.* the *Plusiidae*\* and *Cucullia*) have very strongly

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\* Have also crested heads.

developed thoracic crests, and that some flowers which are especially favorites with them have long, exserted, ascending stamens and styles (*e. g. Echium vulgare* and *Lonicera Periclymenum*). If the stamens in these plants were short, the pollen would have little chance of being brushed off by the thorax of the moth, and it does not readily adhere (as the sticky pollen masses of the orchids do) to the haustellum, and if the thorax of the moth were smooth the pollen would not be so liable to be brushed off, even though the stamens are exserted ; whereas with exserted and ascending stamens in the flower and crested thorax in the moth, we have every condition necessary to insure a greater or less quantity of pollen being conveyed from one plant to another. In the *Labiatae* the stamens, though so few, seem to be especially arranged in many species, so that every chance may be afforded of pollen being carried. In *Ajuga reptans* and *Teucrium Scorodonia* the stamens are exserted and ascending, and are four in number — two long and two shorter. An insect therefore in plunging its head into the corolla would almost necessarily brush all the four stamens. These plants are much visited by moths.—*Journal of Botany*.

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## RELICS OF A HOMESTEAD OF THE STONE AGE.

BY CHARLES C. ABBOTT, M.D.

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THE interest that centres in every isolated arrow point or rude stone axe that we chance to come upon, as it is lying in the field — the train of thought that such relics excite in every intelligent observer, absorbing as it is, pales into a commonplace occurrence, when we happen to meet with a series of stone implements of many forms, that epitomize, in their individual and collective characters, the habits, and occupations of their Stone Age owners ; and to a far greater extent is this the case, when these collected relics are seen lying in the very spot where their ancient owners left them : the corn-mill and its crushing-stones by the hearth, still black with ashes ; the hatchet near by, that was used to split the marrow bones of animals ; the polished horn-stone skinning knife, and skin dressers ; and back from the fire-place, in separate piles, the battle axe, spears and arrows of each inmate of that household.